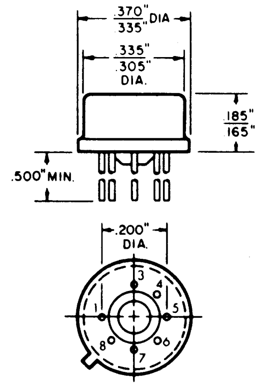
SYLVANIA ECG semiconductors

ECG703A

RF/IF AMPLIFIER, OSCILLATOR AND MIXER

DESCRIPTION

The ECG703A integrated circuit is an RF/IF amplifier intended for use as a limiting or nonlimiting amplifier, harmonic mixer, or oscillator useful to frequencies in excess of 100MHz. Designed for use with transformers and/or tuned circuits, the amplifier eliminates the biasing resistors, bypass capacitors, and coupling capacitors required in conventional amplifiers; operation is essentially unilateral, and the circuit has a symmetrical output limiting characteristic when operated with suitable load. This provides increased power gain, simplified tuning, and superior limiting performance which greatly reduces the detuning, phase shift, and blocking that occur when conventional amplifiers saturate.



Base - Bottom View

A comparison between a silicon RF transistor and the ECG703A, both operating at 10.7 MHz with a +12V supply illustrates the superior performance obtained with the integrated circuit.

The ECG703A is shown schematically in Figure 1. Operated as an amplifier, the signals are transformed-coupled into and out of the device. The amplifying transistors, Q3 and Q4, operate as a common-collector, common-base pair providing high isolation between the input and output of the integrated circuit. The bases of Q3 and Q4 are biased by the voltage drop across the two diode-connected transistors, Q1 and Q2. These transistors also form a low-impedance a.c. bypass for the base of Q4.

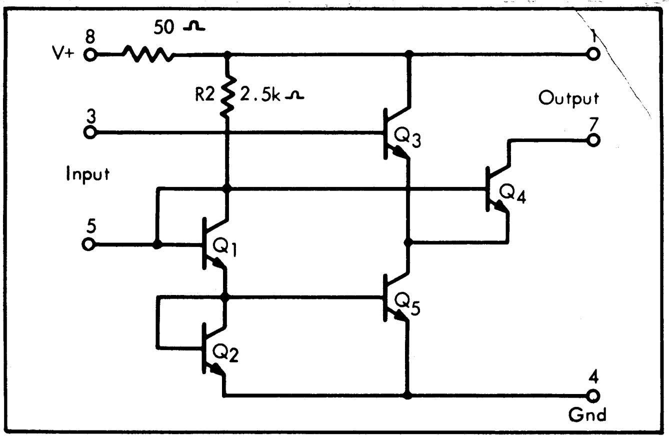
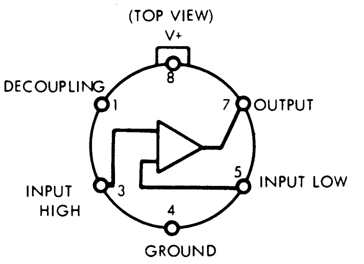


Figure 1.

The amplifying transistors share equal emitter currents from the current source transistor, Q5. The current from this source is equal to that flowing in R2 because of the close matching between Q2 and Q5. The collector of Q4 can be decoupled to ground by an external capacitor as is usually required in high-gain, high-frequency multistage amplifiers. The supply voltage is fed through the internal decoupling resistor, R1.



NOTE: PIN 4 CONNECTED TO CASE

Figure 2.

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Typical Characteristic	Transistor SE1001	ECG703A
Transconductance	90,000 μmhos	30,000 μmhos
Phase Shift	34°	17°
Feedback Capacitance	2pF	0.05pF
Input Resistance	360 Ω	3000 Ω
Input Capacitance	15pF	7pF
Output Resistance	1500 Ω	35,000 Ω
Output Capacitance	3.5pF	3.5pF
Available Power Gain	32dB neutralized	41dB unneutralized

PIN CONNECTIONS

Figure 2 shows the pin layout of the device, as seen from the top of the integrated circuit.

Pin 1: This is the output decoupling terminal, usually bypassed with a capacitor when it is desirable to isolate individual stages from a common supply line in multi-stage amplifiers.

Pin 3: This is the signal "high" input terminal to the amplifier.

Pin 4: This is the ground, or power supply common terminal.

Pin 5: This is the signal "low" input terminal and is internally connected to ground through a pair of diodes. NEVER apply an external voltage to this pin as damage to the circuit could result from excessive current flow through the low forward resistance of the internal biasing diodes. The maximum voltage applied BETWEEN pins 3 and 5 must be less than 5 volts.

Pin 7: This is the output, and is normally connected to the positive supply voltage or decoupling pin through a transformer or tuned circuit. DO NOT apply negative voltages to this pin or damage to the circuit will result. Maximum positive voltage (including ac signal swing) must be less than 24 volts.

Pin 8: This is the positive supply terminal and is normally connected to +12 volts, although operation with reduced performance is possible down to 6 volts. Maximum positive voltage must be less than 20 volts. DO NOT apply a negative voltage to this pin or damage to the circuit will result.

CIRCUIT APPLICATIONS

1. RF Amplifiers

Figure 3 shows the ECG703A used as a 10 MHz amplifier. The input signal is coupled to the amplifier through the L1-C1-C2 tank tuned to 10MHz; the capacitive divider C1-C2, provides impedance matching to the source. A similar network, L2-C4-C5, connects the amplifier to the load. A shield should be used between the input and output tuned circuits to prevent radiation between them causing oscillation.

Figure 4 is a similar amplifier designed for 30MHz operation. Another 30MHz amplifier, using transformer coupling rather than capacitive matching, is given in Figure 5.

An amplifier with a symmetrical output voltage limiting characteristic can be obtained from the circuit of Figure 5 by a minor alteration in the output transformer. The effective turns ratio is adjusted so that the load seen by the amplifier is low enough that current limiting occurs before the output transistor saturates. This is shown in Figure 6.

The ECG703A is also useful at higher frequencies, although the available gain is somewhat reduced. Figure 7 shows a 100MHz RF amplifier, and Figure 8 is a 200MHz amplifier. Reverse AGC may be obtained by bleeding current from Pin 5, thereby reducing the value of the current in the amplifying transistors.

2. Complete IF Strips

The excellent limiting characteristics of the ECG703A make it particularly suitable for use in 10.7MHz IF strips. Figure 9 shows the use of 4 amplifiers in a high-quality FM tuner.

A 30MHz IF amplifier is useful for microwave or radar receivers as given in Figure 10. Placement of parts should be done with care, with good shielding between stages, for best results.

3. Oscillator

The design of oscillators is usually not undertaken by the experimenter because of the large non-linearities encountered. Things such as variations of input impedance and loading with signal level cause difficulty, particularly if algebraic design equations are used. One advantage of the ECG703A, however, is that its input impedance increases with signal level, thus, considerably simplifying oscillator design and predictability of performance.

Figure 11 shows an oscillator designed for 10 MHz operation. Oscillation at other frequencies can be obtained by suitable scaling of component values. An interesting use of this circuit is as a short distance transmitter. It is possible to modulate the oscillator by inserting an audio frequency modulator between the tank circuit and Pin 1, as shown in Figure 12. This could be used as a 1 MHz oscillator for broadcasting into a table radio, for example.

4. Color TV Circuit

Figure 13 shows how the ECG703A can be used in a 4.5MHz intercarrier sound system for a color-television receiver. In a color set, the 4.5MHz sound IF is not generated in the video detector as it is in a black-and-white receiver. In this circuit, a separate transistor sound detector, driven from the final video IF amplifier stage is used to develop the 4.5MHz intercarrier sound IF. The ECG703A driver transformer is tuned to 4.5-MHz. The output of the circuit drives a conventional ratio detector, which provides good AM rejection well below full limiting. Under normal signal conditions, the system operates in full limiting with excellent AM rejection and distortion characteristics. Sound quality is good under reduced signal-strength conditions.

The circuitry for an injection-locked crystal oscillator used to re-establish the 3.58 MHz subcarrier in a color-TV receiver is illustrated in Figure 14. The positive feedback to start and sustain oscillations is taken from a capacitive tap in the output tuned circuit. This voltage is fed back through a narrow-bandpass crystal filter network to the ECG703A input. The burst transformer induces the chroma reference synchronizing voltage directly into the feedback loop of the oscillator, thereby locking the oscillator in phase with the transmitted burst.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	20V
Output Collector Voltage	24V
Voltage Between Input Terminals	±5.0V
Internal Power Dissipation	200 mW
Operating Temperature Range	0°C to +70°C
Storage Temperature Range	-65°Cto+150°C
Lead Temperature (Soldering -60 Second)	300°C

More detailed technical discussions of the integrated circuit may be found in the references listed below:

Blaser, Larry, "An Integrated Circuit for Consumer Products," Electronics World, October 1966.

Estep, G.J., "A 30 MHz IF Strip Using Integrated Circuits," 73 Magazine, July 1967.

Giles, J. N., Linear Integrated Circuits Applications Handbook, pp-105-113, Fairchild Semiconductor.

von Recklinghausen, D.R., "Integrated Circuit IF Amplifier Used in New FM Receiver," Electronics World, April 1967.

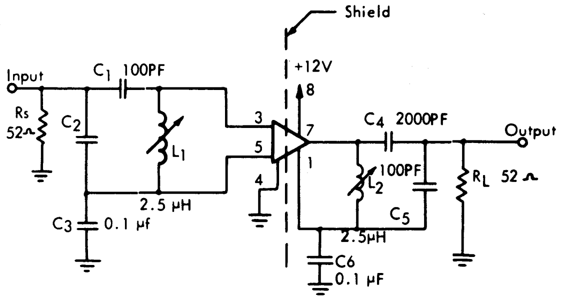
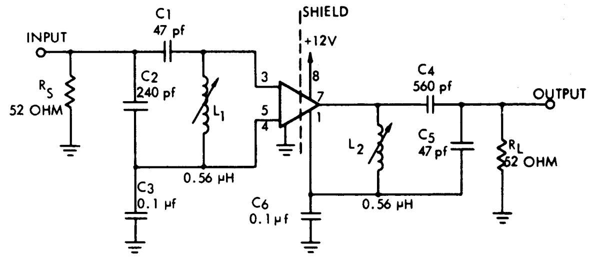
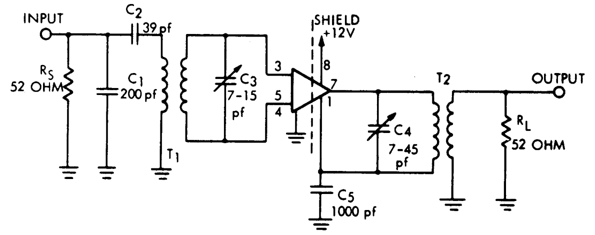


Figure 3. 10 MHz RF Amplifier



POWER GAIN = 35 db
BANDWIDTH = 500 KHz

Figure 4. 30 MHz RF Amplifier

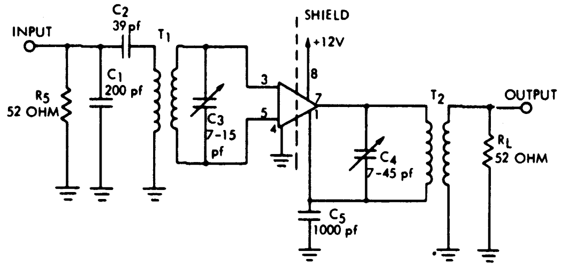


TRANSFORMERS	T1	T2	WIRE SIZES
PRIMARY	10T	12T	#22
SECONDARY	10T	1T	#22

CORES ARE MICROMETALS #T44-10

POWER GAIN = 35 db
NOISE FIG. = 1 MHZ
BANDWIDTH = + 6 db

Figure 5. 30 MHz RF Amplifier

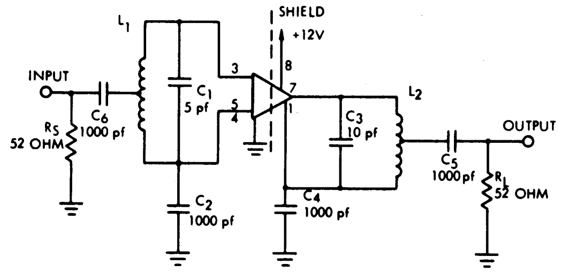


TRANSFORMERS	T1	T2	WIRE SIZE
PRIMARY	10T	12T	#22
SECONDARY	10T	3T	#22

CORES ARE MICROMETALS #T44-10

POWER GAIN = 30 db
BANDWIDTH = 1.6 MHz
NOISE FIG. = 6 db

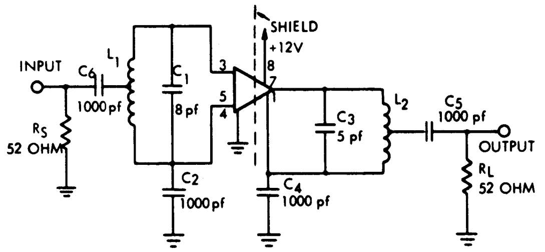
Figure 6. 30 MHz Limiting RF Amplifier



L1 = 8 TURNS AIRSPACED. TAPPED AT 3.5 TURNS
L2 = 8 TURNS AIRSPACED. #20 TAPPED AT 7.5 TURNS
COIL DIAMETER 1/4 INCH

POWER GAIN = 20 db
NOISE FIG. = 6 db
BANDWIDTH = 5 MHz

Figure 7. 100 MHz RF Amplifier

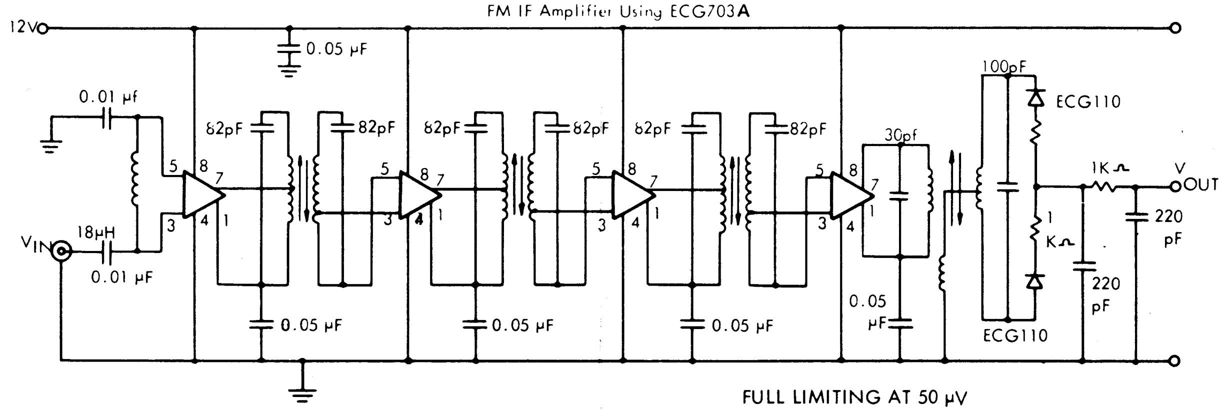


L1 = 3T #20 AIR SPACED. TAPPED AT 1.5T
L2 = 5T #16 AIR SPACED. TAPPED AT 1T
COIL DIA. 1/4 INCH

POWER GAIN = 14 db
NOISE FIG. = 7.5 db
BANDWIDTH = 10 MHZ

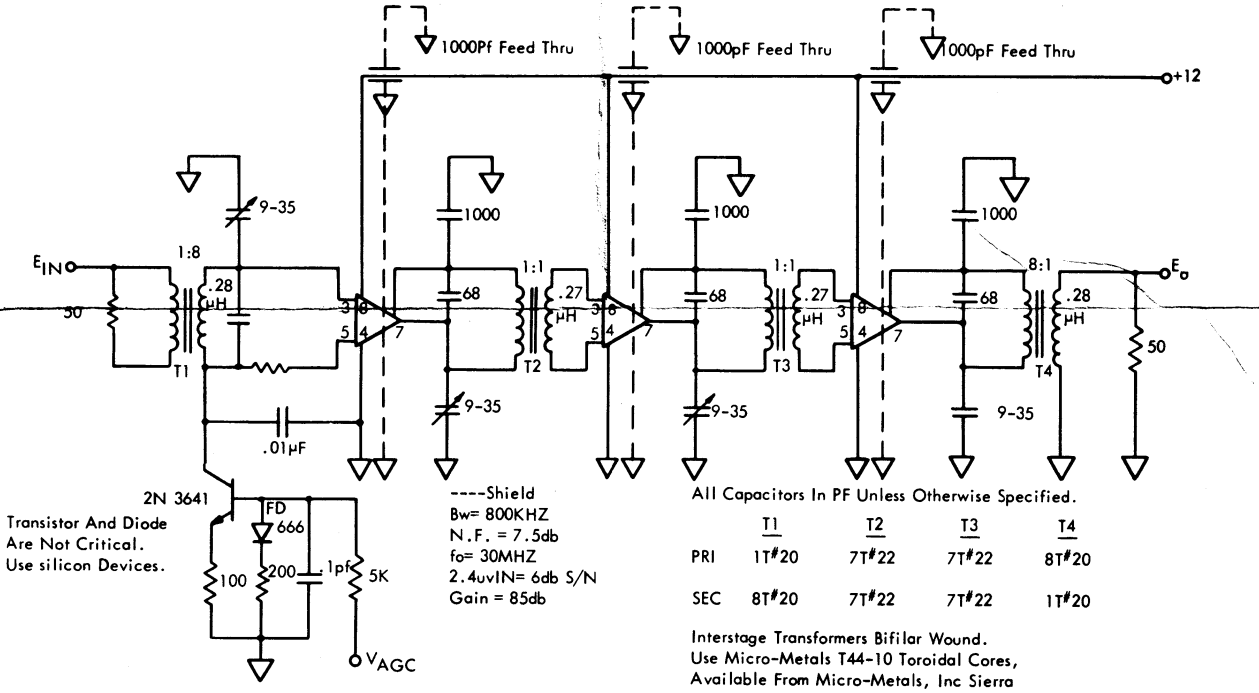
Figure 8. 200 MHz RF Amplifier

FM IF Amplifier Using ECG703A



FULL LIMITING AT 50 µV
INPUT
GAIN/STAGE 26.5db
PP SEP OF DETECTOR 800KHZ
CURRENT CONSUMPTION 27 MA

Figure 9. 10.7 MHz IF Strip for FM Tuner



Transistor And Diode
Are Not Critical.
Use silicon Devices.

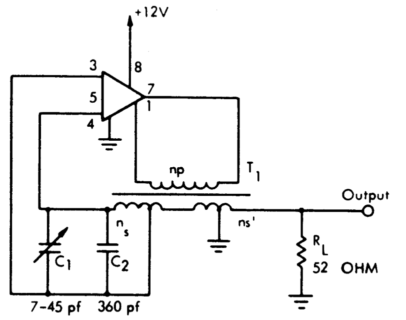
----Shield
Bw= 800KHZ
N.F. = 7.5db
fo= 30MHZ
2.4uvIN= 6db S/N
Gain = 85db

All Capacitors In PF Unless Otherwise Specified.

	T1	T2	T3	T4
PRI	1T#20	7T#22	7T#22	8T#20
SEC	8T#20	7T#22	7T#22	1T#20

Interstage Transformers Bifilar Wound.
Use Micro-Metals T44-10 Toroidal Cores,
Available From Micro-Metals, Inc Sierra
Madre, Calif.

Figure 10. 30 MHz IF Strip



n_s = np = 10T #24 BIFILAR WOUND ON
MICROMETALS T44-10 CORE
$n_{s'}$ = 5T #24 WOUND OVER
n_s AND n_p

Figure 11. 10 MHz Oscillator

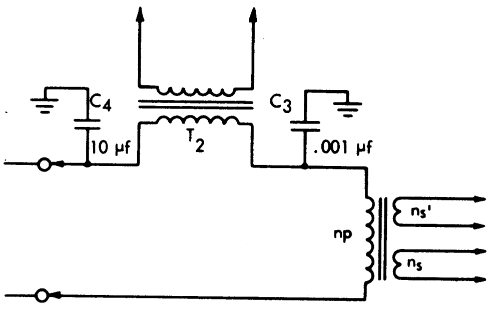


Figure 12. Method of Connecting Modulator to Oscillator

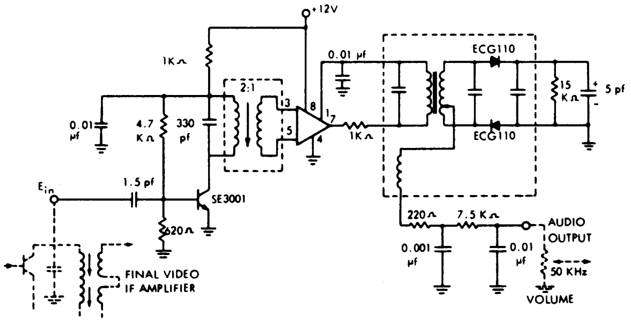


Figure 13. Color TV Sound-IF Amplifier

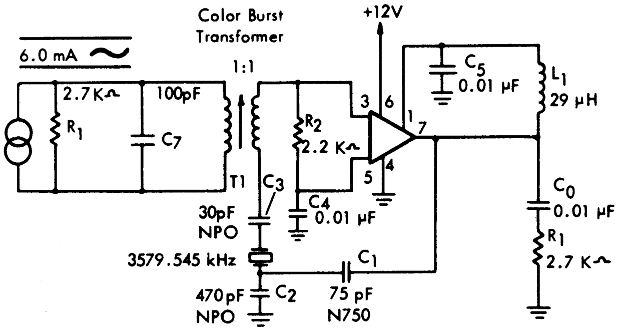


Figure 14. 3.58 MHz Injection Locked Oscillator for Color TV

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